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THE GRANITES OF CARBON COUNTY, MONTANA: A DIVISION AND GLACIER FIELD OF THE SNOWY RANGE.

BY

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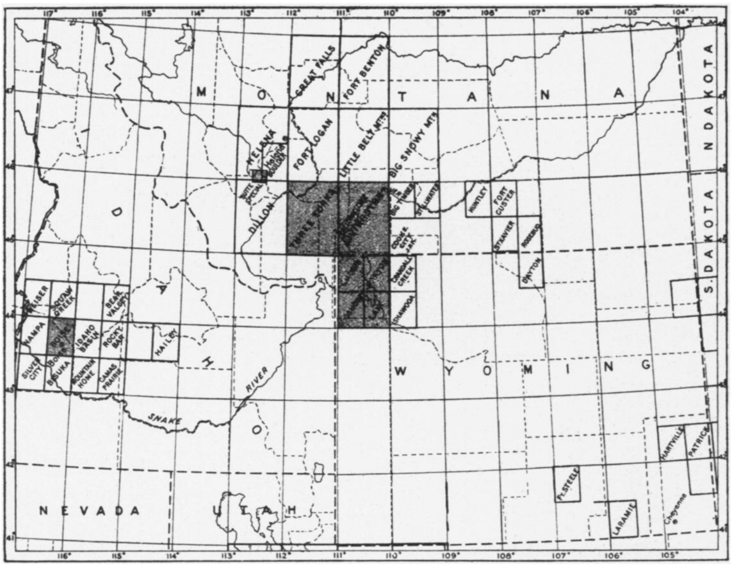
That part of the Rocky Mountain uplift, culminating in Granite Peak (12,824 feet), between the prairie of Carbon County, Montana, and the southern boundary of that State, has remained unmapped, and its more elevated parts unvisited and unnamed. Within an alpine area, at the head of the two Rosebuds, East and West, at a general altitude of about 10,000 feet, and above the timber line, a great number of summits tower 2,000 to 3,000 feet higher. Granite Peak, according to Mr. Gannett, is the crowning summit of Montana. From its mantle of perpetual snow gathers the névé of powerful active glaciers. Other remarkable glaciers, at the head of the West Rosebud, including Grasshopper Glacier, have their névé on two sides of Zimmer Mountain. Several glaciers descend in separate channels from one great névé field at the head of the same stream, and especially from the Sawtooth massif. The Broadwater branch of Clark's Fork, and its supreme head, has its source in a glacier nearby on the opposite side of the divide, and in another on the side of Mount Wilse. The Fishtail falls from a glacier on Mount Wood; the East Rosebud from another on the north side of Mount Dewey. Above the névé fields rear bare, untrodden summits of the peaks, named, too steep for mantles of snow.

Prospectors from the mining camp of Cooke, advancing a futile search for minerals near a score of years ago, above the timber line, to Goose Lake pass, and the base of Zimmer Mountain, gave some of these and a few other names to prominent topographical features that came within their ken. Turned back from their quest at the snow fields and glaciers, and unrewarded by mineral discoveries, even the hardiest never forced the chasms or braved the desolate heights beyond. To these adventurous pioneers, a few of whom still linger about the now nearly deserted camp, the high mountains to the north still remain *terra incognita* and a mystery as for nearly a quarter of a century past. So, too, with the nearest dwellers on the opposite side.

The whole tract is absolutely bare of vegetation except margins of lakes and hundreds of lakelets, which are sometimes fringed with sod. No game trails are found above the timber line, and all upper waters are destitute of fish. A few aboriginal arrowheads and obsidian chips, picked up near the divide, proved the only evidence of occupation by man that came to the knowledge of a surveying party under charge of the writer during the summer of the year 1898. No sign of the axe, nor anything like remnants or scars of camp fires were seen even at the timber line. The inevitable and irrepressible tin can, which mainly constitutes the kitchen midden of the present nomad the world over, was conspicuous by its absence.



Reference is here made to the unmapped tract northeast of the Yellowstone National Park, which in the course of exploration was conveniently designated as The Granites. Its position is between the Stillwater and Rocky Fork. It compasses the numerous head-waters of the East and West Rosebud, flowing to the north, and of Crazy Fork and the Broadwater—upper tributaries of Clark's Fork. All of these mountain streams are waters of the Yellowstone.

This designation is in distinction from the easterly division of the same range known as the Beartooth, a less elevated mountain plateau, culminating in Beartooth Mountain of Wyoming.

Both The Granites and the subordinate Beartooth plateau, thus distinguished, form a part of the Absaroka division of the Rocky Mountains in southern Montana, or of the Snowy Range of Montana, as discriminated from the Absarokas of western Wyoming. These ranges are separated by Clark's Fork Cañon. Near the head of its lowest tributary, but bearing the name of Clark's Fork, lies Cooke City in an amphitheatre of mountains at the base of Index and Pilot peaks, at an elevation of 7,645 feet.

Whatever importance may attach to this mining camp within the original purpose of its location some twenty-five years ago, special advantages of position are not to be denied, even by those who fail to esteem a degree of isolation all but complete. In the deep valley of Soda Butte Creek nestles the "city" like a Swiss village. The mountain sides are covered with balsam and spruce. Republic Mountain (10,225') stands out from the rest of the Index base, indented and hollowed out by erosion into lofty coves—or culs-de-sac—common to the lava summits of the region. The great gently undulating reef of paleozoic limestone, which is so bold a feature in the Index base on Clark's Fork, here likewise presents sharp-cut edges, weathered into long stretches of bluff. The base of all the surrounding mountains is the granite complex, a part of the same expanse and uplift that culminate in Granite Peak. The great plate of conformable limestones, belonging to the Silurian and Carboniferous series, spreads out beyond the Stillwater, and save where bared and sculptured by erosion is penetrated and overflowed with volcanic rocks surmounted with andesitic lavas. Clark's Fork probably follows in part a line in a great vertical fault plane, no extension of the limestone appearing north of the Index base, at the foot of which flows this rapidly gathering stream. At the extreme head of the Clark's Fork bottom the limestone, however, is still in force in Sheep Mountain, beyond which on the same meridian to the north all trace of it disappears. The Post Laramie re-elevation of the granite has cut it off. If ever borne to lofty altitudes by this uplift, its destruction by erosion has been perfect. No remnants of anything of the kind are to be found in the glacial gravels and alluvions of the high mountains. All the valleys descending to Cooke are from local glaciation, except that of Miller Creek, which is excoriated by fluvial erosion from the limestone series. Ancient surfaces of the granite base are everywhere ice-smoothed.

Whatever may have been the title to the honor of giving to Cooke its name—it might have been not inaptly known as Pass City, if "city" it must have been. All mining camps in its day and generation in the Absarokas were *cities*. Nye City, at the northern base of The Granites, has passed from off the face of the earth. Solomon City and Lake City had their rise and fall. Both are deserted villages, which seem to have been abandoned in haste, without removal of goods and chattels. Of all the "cities" of the mountains in southern Montana, Cooke alone survives, though its population has dwindled from 500 to less than 100. A carriage road, such as it is, between Mammoth Hot Springs and Cooke, through the National Park, follows the water gap of Soda Butte Creek. Its extension over the Soda Butte divide gives access to Clark's Fork and the Big Horn Basin by way of Dead Indian Hill. At the head of Clark's Fork are two passes over the Stillwater divide, namely, West Pass (9,694′), between Henderson Mountain and Scotch Bonnet, and East Pass (9,717′), between Scotch Bonnet and Sheep Mountain. Other and better known passes are Chimney Rock (9,608′) and Black Warrior (9,654′), separated by Crown Butte. All are within a stretch of two miles, and descend into the Stillwater Cañon, which affords a horse trail through The Granites to the open prairie to the north. Another more elevated pass at the head of the Stillwater, over the Slough Creek divide, is known as Wolverine. If for no other reason for existence, Cooke holds its place as the natural gateway for whatever travel finds occasion so far from beaten paths. Pleasure travel in the National Park seldom extends to the northeast corner of that domain, from which Cooke is less than three miles distant. In point of the picturesque, it is excelled by no scenery within the Park, which indeed, full of wonders as it is, offers to the tourist but little temptation to linger. A summer climate at high altitudes finer than that of Cooke would be difficult to find, and a more attractive landscape hardly possible.

But a single water gap cuts through The Granites, that of the Stillwater. This stream, in fact, borders the western edge of the group, so distinguished from the rest of the Snowy Mountains of Park and Carbon counties.

Outfitting at Bozeman with nine pack and eight saddle animals, fresh from the range, the writer's party, eight persons in all, reached Cooke July 24, from Cinnabar, after a detour of a few days in the National Park. From the Grand Cañon of the Yellowstone, the Mt. Washburn trail was followed to Tower Falls and Baronett Bridge.

A pest of horse-flies, more or less annoying on the park highways in the heated part of the day, came to an acute stage on the last day's march, greatly to the suffering of the animals, some of which were beside themselves. From these vampires there is no escape in mid-summer except in a strong breeze or at the higher altitudes. For persistence and execution they outdo all insect kind. As an inevitable and unmitigated nuisance and "kill-joy," abominated by the nerves as well as the flesh, the horse-fly of the Rocky Mountains takes precedence. His bite is that of the carnivora. While horse-flesh is exquisite to his taste, he does not refuse to whet his appetite on any blood that circulates or even on hanging meat. He loves a man next to a horse, and the shelter of a tent strongly appeals to his self-indulgent nature.

It is hardly necessary to explain that movements of a party in the wilds of the Rocky Mountains are more or less governed by provision for pasturage, any other kind of forage being out of question, and indeed quite beyond the craving of range animals. Knowing no other subsistence than that of the range, nor any keener relish than for bunch grass, all supreme conditions are fulfilled where this is to be found, even though at some distance from camp. Almost any growth of grass answers in a pinch or in default of bunch grass. Under the hands of skillful packers, who are generally owners of the animals, and, therefore, sure neither to overburden nor to encourage long marches, a lot of pack animals come out of a season's work but little the worse for wear, and usually sleek and muscular, if not plump and even fat. A tethered bell-mare and a few faithful followers, hobbled, serve to keep the drove fairly together when turned out to graze.

A plane-table survey to connect with published sheets of the United States Geological Survey was started at Cooke, not without difficulty. As the "city" has never been astronomically located, and the guide meridian of the United States General Land Office Survey is certainly out of the way, nothing remained, for want of other equipment than plane table and alidade, but to occupy and locate commanding summits, like Henderson and Republic mountains, by the three-point method, with lines to established summits as located on National Park sheets of the Geologic Atlas, or as astronomically determined in a few instances in advance of topographic work. The location of Cooke followed in the course of much skirmishing for points, and was finally satisfactorily checked. This arduous work was executed by the younger members of the party—all sturdy climbers.

In order to advance into the mountains, of which little or no knowledge had been gained at Cooke from prospectors and hunters, a march was made to Kersey Lake at the end of the wagon road to the north. From the meadow beyond a hay scow with the dunnage was poled to the head of the lake, whence a trail was scouted and blazed by two of the party to the mouth of the cañon of Crazy Fork. Explorations toward the divide developed the practicability of getting the animals up to the timber line. This was accomplished after pioneering a trail with axe and shovel, and camp moved to an elevation of 9,230 feet near good forage at the head of Crazy Fork—an ideal site for an elevated camp, in an amphitheatre of granite bosses. Except arrow heads and chips, pointing to remote excursions of Indians, no signs were about of previous visitors. These were found on the shore of Island Lake at the head of one of the tributaries of the East Rosebud.

The ascent of Mount Dewey from camp and return proved a good climb for a long August day. This commanding snow-capped mountain, which crowns the divide, was so-named in honor of a friend, the echo of whose valiant exploits at Manila reached the surveying party at Cooke. Owing to treacherous mountain weather, including cloud-bursts on the summit driven by furious gales, the ascent was time and again made in vain only to be repeated. Plane-table and photographic work was only accomplished after several attempts not without exposure to the elements at their worst, enough to tax the endurance of the most hardy. The ascent from Camp Timberline was by way of two intermediate ridges, dissected into summits and draws. Explorations in several directions were all necessarily through steep gorges and water courses, choked with granite blocks of all sizes, piled *en masse*, the water tumbling far beneath. Such climbing, at the best arduous and sometimes difficult, becomes after nightfall extremely hazardous. The way, then, was sometimes missed by returning explorers and camp tardily reached only by happy chances, aided toward the end by reflections from fires kept burning as beacons by anxious watchers. The exertions and danger of night work of this kind over such rugged and pathless ground were speedily forgotten in ready welcome and good cheer. So, too, were all admonitions against recurrence of like adventures, of which the worst, perhaps, were apprehensions in camp of accident, with wide scope for grave imaginings. To wanderers themselves, thus benighted, always opened the cheerless prospect of a frosty bivouac without shelter, fuel or food, and perhaps in rain and sleet, a thunderstorm after midnight proving within the experience of the party the rule rather than the exception. The probability of such a misadventure, though perhaps the least serious of many possibilities, little tended to allay the solicitude of the rest of the party.

Mt. Dewey drops off some 2,760 feet into a deep cañon on the north side, with a sizable glacier at the head, and ending in a deep lake to which the name of Cañon Lake was given. This is one of a series of lakes connected by the East Rosebud, of which Island Lake, at the foot of Mount Dewey, is the highest. The Rosebud outlet of Cañon Lake into Long Lake plunges 200 feet in falls. A little below the latter, about two miles above the grand cañon of the East Rosebud, this stream again plunges in splendid falls.

Island Lake (9,987 feet) appears to be identical with the lake indicated on the map of the General Land Office as the head of the East Rosebud; its name is therefore retained. It is easily reached from Timberline Camp by Pavement Pass, near the divide. This name was suggested by a remarkable tessellation of granite blocks, worn by ice and water to the smoothness of a city pavement.

The Broadwater, the head proper of Clark's Fork, takes its name from characteristics of its lower course. Like Crazy Fork, to the east, also a tributary of Clark's Fork (of the Yellowstone), it heads at the divide in ice-formed lakes, of which the overflow is through a series of lower lakes separated by deep cañons, mostly gorged with granite blocks fallen from the precipitous walls. The descent of Crazy Fork is the more rapid, and over two falls, both below its box cañon. Still further below, the forces of gravity and weathering agencies on its perpendicular walls are attested on a grand scale of destruction. The bottom is strewn with gigantic blocks many-deep, which likewise pile up in an immense talus against the east wall.

Above the timber line the granite is washed clear of soil or small detritus; it is strictly bare and barren. In circumstances favorable for preservation of ice-smoothed surfaces, these evidences of glaciation are frequently perfect. On many a towering mass no footing can be found ; no passage anywhere is effected except by climbing.

The granite is of two periods, the earlier being probably of Archean age, and the later dating from the Post-Laramie elevation. The latter, a more or less foliated and basic variety, is involved in the former, which is extremely feldspathic, and often of pinkish complexion. Trap and porphyrite dykes traverse the granite complex. On Crazy Fork porphyritic intrusions were seen only in Dewey Mountain. Toward the west porphyritic dykes in great number bring in a type of topography quite distinct from the type prevailing at the upper waters of Clark's Fork. It is asserted by serrated ridges and less expansive massifs, owing to unequal erosion and disintegration between the several kinds of rock. Throughout the broad granitic base of the Snowy Range, both in Montana and far to the south in Wyoming, the same distinctions and relations are observed.

From Camp Timberline The Granites were explored as far as practicable. Returning to Cooke by the same trail, now well-trodden by traffic between Cooke and the high camp, the party divided from a camp at Sheep Mountain in the Clark's Fork bottom for several fields of exploration. In persistent wet weather a party of three, composed of Messrs. A. B. Wood, A. B. Wilse and Russell Kimball, made trail with pack and saddle animals to a bivouac at Goose Lake (9,730 feet), afterwards remembered as Camp Misery, the animals returning the same day. The rest of the outfit moved up two days later, arriving in a pelting hailstorm. The mountain party with the plane-table came late into camp drenched to the skin. Although the special performance of the one folding camp-stove in camp was fumigation from every joint, it proved for several days an object of unvarying attraction and solicitude. A few weather-beaten spruce, straggling above the timber line, afforded necessary fuel. A foot trip from here was made to Grasshopper Glacier, just over Goose Lake pass, between the Stillwater and the West Rosebud.

The névé of this remarkable glacier is shared by the summit of Zimmer Mountain and Mt. Wilse. It mantles the saddle between two of the upper waters of the West Rosebud. An island of granite and porphyrite blocks and detritus occupies the western descent. To casual observation, this insulated tract appears to be ice-floated, an impression not easily dispelled in setting foot upon it. Motion is implied in the most alarming manner, huge blocks of granite under one's immediate eye becoming displaced, especially on the lower side, with internal and external sounds that dispose to flight. Tons of rock were violently shifted while the writer was skirting the lower edge, so that safety was sought in the slushy surface of the glacier.

From the absence of anything like a descending train of blocks, it seems probable that this islet actually rests on a solid foundation, the surface being in an advanced stage of dissolution. Like the two islets of the Brenva Glacier of Mt. Blanc, it is completely involved in plastic ice, which, bending about the obstruction, exerts an immense pressure on all sides and superficial edges of the islet. To the creeping ice mass, with its internal molecular movement, these edges offer an encircling surface of least resistance. The slope of the surface of the glacier is at an angle of not less than 25 to 30 degrees. Hence accelerated flow toward the top—especially under action of the sun. The emission of sounds on the islet is doubtless incidental to displacement and crushing of blocks of rock at shallow depths in this irresistible grasp of ice.

A really astonishing feature of the glacier is the one which naturally has given name to it, as known to prospectors from Cooke. Myriads of grasshoppers, in periodic southward flight from the prairie, have succumbed to the rigor of cold and wind, to be engulfed in the snow and finally entombed in the ice. Thousands of tons of grasshopper remains are the principal morainal material fringing the lower edge, washed out in furrows wherever by action of the sun the surface has been grooved into runlets of descending water. No fragment of ice can be broken so small as not to contain grasshopper remains, melting and regelation having torn all but a small proportion of the fallen insects into a coarse powder, only the more enduring parts having resisted reduction. Grasshoppers that gained the west side of the pass seem to have been laid low before further descent, all congealed patches of snow in the pass likewise being charged in the same way.

The plates, taken on different occasions by Mr. Wilse, of Seattle, photographer of the survey, successfully bring out in curvilinear form lines of surface motion—aided by deep coloration imparted by furrows of grasshopper remains, washed out by runlets and naturally disposed in parallel lines. It requires a number of plates to present the ensemble of the Grasshopper Glacier and also of the Sawtooth glaciers. A panoramic collection of views exhibits this, as far as practicable without more time and labor than could be given to photographic work, especially in the treacherous weather which prevailed. The summits of Mount Wilse and Zimmer Mountain were observed in cloud, and the upper parts of the névé lost to the camera. The views taken were at the cost of indefatigable labor and hardy endurance on the part of the photographer, who combines with professional skill in field photography rare accomplishments as a topographer, along with sturdy qualities as a mountaineer. Remains of individual grasshoppers were also found in the upper edge of the ice-sheet formed beneath the snow crests of Mount Dewey. The ice in such circumstances not being subject to movement, the entombed insect is preserved in perfect form.

The timber line camp at Goose Lake was left September 3d, after a heavy fall of snow incidental to a spell of wintry and gusty weather, from which even range horses, without their winter coats, suffered not a little. All of the animals, when driven in for saddle and pack, were sulky and disposed to buck. Camp was again pitched at the Sheep Mountain camp on Clark's Fork. Three days later Messrs. Wood and Wilse, taking advantage of a favorable turn in the weather, were again escorted to Goose Lake for a night camp, whither the following morning they set out foot-loose, in light marching order, for a hard trip across The Granites to the mouth of the grand cañon of the West Rosebud. At the end of the fifth day the explorers joined the rest of the party in camp, on the Stillwater, near the mouth of the West Fork, none the worse for their exposure, but with foot-gear, together with much of their other rig, in the last stages of dilapidation.

The Sawtooth summits had been visited, and a number of high peaks ascended. To some of these names have been given, as follows: Mount Villard (11,500′); Mount Spofford (11,580′); Mount Fox (11,000′); Mount Wilse (11,611′); Mount Wood (12,486′); and Mount Hague (11,800′). Aneroid elevations were determined for a further number of important points.

As camera and plates could not be taken along, no photographs can be given of the most rugged scenery of all. The plane-table also had to be left behind. Several of the mountains named above were scaled and approximately located by angle and azimuth with pocket instruments. Of the whole number, including Granite Peak, which was scaled to an elevation of 11,447 feet, only Mt. Wood can be seen from the prairie at the northern base. From a greater distance a dense array of crests comes into view—thus far, except Granite Peak, without identification.

A fine glacier is supplied from the expansive névé culminating in Granite Peak. Its descent is into waters of the West Rosebud.

Mt. Wood is the highest of three peaks of the expansive massif fronting the range and rising grandly from Rosebud Cañon and the snow fields above. The name given to this mountain, previously unnamed, so far as could be ascertained, is in honor of my friend and companion, who took its elevation, and to whose aid and energy in mountain-work many of the more important results of the survey are to be ascribed.

From the Stillwater the Snowy Range of Park County was crossed by the picturesque Lodge-pole trail to Boulder Creek over several passes. The cañon of this beautiful mountain stream was followed to the upper waters as far as the deserted mining camps of Independence and Solomon City. Crossing the several timbered divides to the East Fork of the Boulder, Slough Creek and Lake Abundance, the old camp at the head of Clark's Fork was reached Sept. 26th. Two days later in-door quarters were again occupied at Cooke. On Oct. 4, under bright skies, after a snowstorm lasting five days, march was resumed, this time for Red Lodge, over the Beartooth division of the Snowy Range from Smith's Ranch of Clark's Fork. All trails in the mountains were snowed under, and blazes proved misleading. Messrs. Wood and Wilse took up separately the work of finding and breaking trail, occasionally coming together, however. The horse-tracks now of one rider, and now of the other, were followed, always with the conviction that the wrong choice had been made. Steps were often retraced to avoid windfalls. Snow fell from every passing cloud. In night camps pitched in deep snow, the one shovel was in constant requisition. Greatly to the relief of the whole party, the pathfinders came into late camp at the end of the second day's march on Little Rocky Creek, after abandoning hope of being overtaken by the "outfit."

Having dropped too low into the cañon of that creek, egress was found the next morning by a hard climb. The high plateau, culminating in willow-swamp bottoms separated by low divides, was reached about noon in a dry blizzard, increasing toward night, Messrs. Wood and Wilse still scouting in the lead, but to little purpose, as their tracks were soon covered by driven snow. No way down from the snow field practicable for pack animals appearing in sight, a single tent was pitched for the night and the animals turned out to forage beneath the snow.

In spite of driving snow and bleak winds, blowing out of a clear sky, perhaps at 60 miles an hour, packers and cook chose to sleep *al fresco* rather than shake out the frozen canvas. Any hope of sleep inside the tent was dispelled by the fury of the wind, and all surviving energy of the single occupant devoted to the sole purpose of keeping up the tent. What consolation could be had from a smoking stove was impaired by constant danger of conflagration from frequent displacement of the funnel, or from final collapse. The canvas stood till morning, when in a neglectful moment the expected happened, but at a time when assistance was at hand, and the danger of fire averted.

The pathfinders, not having come into camp, were safely presumed to have sought refuge from the tempestuous heights in the bad-lands below. A difficult descent, as afterwards recounted, had been separately made toward night down the steep sides of the lower cañon of Little Rocky Creek. After dragging their own reluctant horses half way down, and finding the way impracticable for pack animals, Mr. Wilse bravely climbed up again afoot to turn off the train from following—by conventional signs to that purpose scratched in the snow. Both reached the bottom about the same time by different courses, but again met on the desert below after dark under the friendly roof of a prospector—thanks for the rendezvous to Mr. Wilse's forethought in setting a candle at the window-pane for his companion.

The wind-stormed "outfit" on top, after some scouting in deep snow, made the descent the next day down the south side of Bennett Creek—striking a blazed trail in the timber. This proved to be the end of the Sheridan trail, which had failed to show up in the mountains. The drop of some 5,000 feet into the bad lands of the Big Horn Basin, near the scene of Miles's battle with the Bannocks, was into comparative summer. The Rocky Fork and Red Lodge trail had been missed at the head of Little Rocky Creek, which should have been left to the east.

After needed rest and forage for the animals, preparatory to their return to Bozeman, the party disbanded October 11th, having been 102 days in the field.

Buffeted by high winds and by frequent snow squalls from the mountains, which had become the centre of almost continual storm, camp on Rocky Fork, above Red Lodge, was kept for a few days longer by two remaining members of the party while preparing for a further excursion to the Sunlight Basin in the Absarokas of Wyoming. The shelter of a wall and an A tent had come to be most precarious, and cooking by open fires impracticable. A new stove made for the emergency at Red Lodge proved equal to all purposes. The road was taken October 21 up Big Horn Basin over Dead Indian Hill. A light winter outfit well loaded the body of the Shutler wagon. No snow lay upon the basin a few miles south of Red Lodge. The whole of it is given over to sheep herders with flocks of over a thousand head. Several cosey looking camp wagons, not unlike such as are often seen in gypsy camps, passed on a day's drive, seemed something at least in the void of a shepherd's life with no companions but his collies and flock.

Unbounded hospitality was found at night at Andrew Chapman's fine ranch on Pat O'Hara Creek.

Dead Indian Hill (8,365′) and creek of the same name at its western base take their name from an incident in one of the numerous Indian fights for which the northwestern part of the Big Horn Basin and the bordering foothills of the Absarokas of Wyoming are memorable. The Sunlight and Cooke wagon road crosses the divide between two branches of Clark's Fork, on a grade perhaps unequalled by that of any other wagon road in the country. The descent of 2,015 feet is made in less than one and a half miles, including a stretch of gentle grade half way down. The descent with heavy wagons is rarely effected except by "snubbing," that is, by felling a tree at the top and attaching it as a drag to the hind axle. These are commonly dropped half way down at the beginning of the reducing grade, not without occasional necessity of repeating the operation farther on. Thousands of snubbing trees pack the roadside. The roadway is obviously the development of a mountain trail. Numerous "cut-offs" have been made by range cattle driven into the Sunlight Basin for summer forage, and back to winter ranges and home ranches at the end of the season.

The descent of Dead Indian Hill on the occasion within the present recollections was made with ordinary brakes, sadly out of condition—the driver only keeping to his seat. On the lower pitch, the steadiness of the team and ready assistance alone prevented an upset from shifting of the dunnage over the wheel.

Notwithstanding moderate weather in the Sunlight Basin, a projected visit to the Sunlight mines on the Sunlight and Stinkingwater divide of the Absarokas (12,000′), was reluctantly abandoned, the mountain trail having already been snowed under, and the miners compelled to descend for the winter, by sliding down the mountain side, not without mishap.

The return to Red Lodge was with pack animals down Clark's Fork box cañon to the end, and thence by the same general course as before over the foot-hills of Beartooth Plateau.

The display of paleozoic and mesozoic strata at the mouth of Clark's Fork cañon is complete in a great fold—incisively truncated by erosion. This uplift is a part of the sharp rise of the same series marginal to the Beartooth Range and The Granites, on the flanks of the granite complex. One of the limestones of the paleozoic series in nearly vertical attitude, which it shares with other members, weathers into serrated forms, whence it may be presumed the name applied to the former division of the Snowy Range. Some of these forms are exquisitely picturesque, owing to unequal erosion and disintegration. Occasional perforation of towering outliers adds to the castellated effect.

The Post-Cretaceous re-elevation of both sub-divisions of the Snowy Range division of the Rocky Mountains—coincident, as may be assumed, with the intrusion of the more recent granite, is evidenced by the continuity of the remarkable coal series of Rocky Fork without material change of dip well into the foot-hills, until finally faulted. But the plane of fault has not yet been reached by the great mine at Red Lodge.

On November 1, a visit was made by wagon to the camp of oil-well borers at the asphaltum deposit on Butcher Creek near the mouth of East Rosebud cañon at the northern base of The Granites. An incident of this visit may perhaps be related. A 12 x 16 wall tent, already but badly pitched, offered shelter to the writer. The folding camp stove was set up inside, for heating and cooking purposes, on an old bed of ashes which it failed to completely cover. An A tent was raised alongside for the rest of the small party. Toward evening half a gale sprang up from the mountains, veering round from their lee to the northwest and steadily increasing until about midnight, when it had risen to about 70–80 miles an hour. In a furious blast down went the A without resistance on the part of the two men underneath, one of whom, with more nerve than nerves, stuck it out till morning, not without a grim sense of amusement, as afterwards confessed, at the struggles going on in the wall to avert a similar collapse. All struggles proved in the end quite in vain, when guys were rent and even eyelets torn out. Decidedly the worst of the resulting chaos of raiment, bedding, stove, camp-kit, etc., proved the saturation of every article with flying wood ashes from under the stove, which fortunately had been suffered to cool and fall to pieces early in the night. Remnants of supper and thrifty provision for breakfast, all came under the searching blight of ashes. Only daylight revealed details of the hopeless havoc that had been speedily wrought. Meanwhile, refuge was found in the borers' cabin at a moment when their framed derrick, the work of a season, came down with a crash. The rest of the night was miserably spent in the cabin, with the interruption of occasional flying sorties out into the gale to rescue some precious instrument, or coveted article of clothing from under the lashing canvas. From beneath the A everything had soared away, except blankets under the weight of their imperturbable possessor. Habiliments, considered important among polite people, were missing, but finally recovered from the brush. Minor articles, usually worn in pairs, never found their mates. If one side of such a provoking and embarrassing situation was more than another impressive—so appeared the ludicrous side. No further nocturnal adventure of the kind, however, proved necessary to force the conviction that endurable conditions for camp life had come to an end for the season. Differing from this one only in degree—numerous vicissitudes, wrought by wind throughout October, had indeed left but little of it worth living. The one tent belonging to the outfit was folded for the last time, and all further attempt relinquished to complete the Cooke City sheet from the north side of The Granites.

The Granites afford, perhaps, the most picturesque alpine scenery to be found in accessible parts of the United States. As a haunt for tourists of the more adventurous sort, and for alpine clubs, they offer superlative attractions, coupled, however, with difficulties not easily overcome. Allusion is here made to the stark sterility of the high parts, and to excessive demands both in physical exertion and expense in providing ways and means for occupying them. Proximity to the National Park suggests eventual addition to that domain. Except for picturesque value they are worthless. The trail blazed on Crazy Fork, well up toward the divide to the timber line, will probably prove the most available for future travel. With some improvement this trail from Cooke could be made popular for mid-summer use. In any other season The Granites, as well as the Beartooth plateau, constitute a storm centre to be scrupulously avoided. Physiographical as well as meteorological conditions all tend to such a forbidding characterization. Granite Peak and Glacier, and Wood Mountain are more directly reached from the prairie with one of the Rosebud bottoms as base of supplies. The cañons of both Rosebuds are impracticable for animals above a mile from the prairie. Few pedestrians have ever attempted to cross The Granites from the north side, and none, so far as I am aware, successfully. It is conceivable that from the Beartooth plateau, where forage is abundant, reached from Red Lodge, access may be found to the culminating parts of The Granites.

Mr. Wilse's photographs of the several glaciers above described attest beyond all question the incorrectness of Mr. William H. Holmes's conclusion that nothing "approaching a glacier in appearance" is to be found "even in the centre of the great mass about the sources of Clark's Fork and the Rosebud." Mr. Holmes's remark is, that he was "unable to discover anything" of the kind, referring to explorations of the Hayden survey (1878). (See U. S. Geol. Survey, Fifth Ann. Rep., 1883–84, p. 347.) That the high parts of The Granites of the Snowy Range, or sources of the streams mentioned, were not visited by that survey is sufficiently clear from its several reports. Nor do any of these powerful glaciers appear in Russell's List of North American glaciers. So far as the writer is aware, no description nor even mention of any of the number has previously appeared in print, except a short account of the Grasshopper glacier—said to have been recently contributed to a local journal by one of the packers of the survey, of which the present pages are a brief narrative.

Approximate elevations, in feet, from aneroid observations, computed by difference from Guyot's table. (Short & Mason's barometer.)

Red Lodge, N. P. Railway station	5,531
Cooke City	7,645
Mouth of Republic Creek	7,592
Republic Mountain	10,225
Republic Pass	10,046
Republic Mine	8,122
Woody Mountain	8,065
Pilot Ridge	10,506
Pilot Ridge, top of limestone cliffs	9,147
Index Peak, highest point scaled	11,222
Soda Butte Pass (Soda Butte and Clark's Fork divide)	8,064
Black Warrior Pass (between head of Miller Creek and Stillwater)	9,654
Chimney Rock Pass (between Crown Butte and Henderson Mountain)	9,608
Lulu Pass (between Fisher Mountain and Scotch Bonnet)	9,718
Bull of the Woods Pass (between Scotch Bonnet and Sheep Mountain)	9,694
Henderson Mountain, west summit	10,233
Henderson Mountain, east summit	9,984
Daisy Mine, Clark's Fork, upper tunnel	9,797
Kersey or Burke Lake	8,123
Panorama Point	8,638
Sheep Mountain	10,418
Crazy Fork Meadow, mouth of Box Cañon	8,371
Timberline Camp	9,230
Island Lake, head of East Rosebud	9,767
Mount Dewey	11,753
Point Lookout, near Kersey Meadow	8,650
Glacier on Granite Mountain	11,300
Point reached on Granite Mountain	12,371
Zimmer Mountain	11,310
Mount Wilse	11,611
Long Lake, West Rosebud	7,645
Grasshopper Glacier (div. bet. West Rosebud and Broadwater)	10,677

Grasshopper Glacier, base of islet	10,513
Goose Lake	9,756
Goose Lake Pass	10,575
Sawtooth Mountain	11,310
Mount Fox (estimated)	11,000
Mount Villard	11,500
Mount Spofford	11,580
Mount Hague	11,800
Wood's Peak (Timberline, 9,634)	12,486
Point of photographic view of Grasshopper Glacier	10,646
Watershed, between Broadwater and Stillwater	9,414
Long Lake (above Rosebud Falls)	7,645
Lake below falls, Rosebud Cañon, head of wagon road	6,582
Stillwater, mouth Goose Creek	7,911
Stillwater, Pratton's Ranch	5,114
Lodge Pole Pass	7,419
Lime Butte	7,759
Divide, bet. upper Deer Creek and Elk Creek	7,722
Smith's Ranch, Clark's Fork	6,817
Beartooth Lake	8,937
General watershed above Beartooth Lake	9,545
Nutting's Ranch, Clark's Fork, at Bennett Creek	4,952
A. Chapman's Ranch, Pat O'Hara Creek	4,760
Bald Ridge	7,994
Dead Indian Hill	8,365
J. R. Painter's Ranch, Sunlight Basin	6,784
Mouth Clark's Fork Cañon, T. Brown's Ranch	4,090
Clark's Fork Cañon, Sunlight Trail crossing	4,430

EXPLANATION OF PLATES.

I.—Zimmer Mountain and Grasshopper Glacier. Islet to the right. Goose Lake Pass, between Zimmer Mountain and South Sawtooth peaks, to the extreme right. Part of Fox Peak (named in honor of Dr. J. M. Fox, of Red Lodge) in the distance to the right.

II.—Base of Grasshopper Glacier on Zimmer Mountain. Islet on extreme right. Mt. Wilse in immediate background of glacier. Mt. Villard (named in honor of Mr. Henry Villard) in the distance. Mt. Spofford (in honor of Mr. C. A. Spofford) on extreme left.

III.—Sawtooth massif and névé field. South Sawtooth on extreme left. North Sawtooth in background. Part of Grasshopper Glacier in foreground to extreme left.

IV.—Combined plates 31A—32A. Second Lake at head of the Broadwater. Glacier to the right at E. N. E. base of Granite Peak. Glacier to the left has its névé on Mt. Villard—the snow-clad peak to the left of it. The rocky summits are a part of the Mt. Villard massif. The first lake at the supreme source of the Broadwater, at the foot of Mt. Villard, lies behind the lake in the foreground.

V.—Glacier Lake. At south base of Mt. Dewey.

Page 200: An index map to Geologic Atlas of U. S. Geological Survey. The sheet covered by private survey (1898) is indicated as COOKE CITY, and, further, by the writer's initials, J. P. K.

NOTE.—The above half-tone plates are from a collection of photographic views (8″ x 10″) numbering some 160. These have been bound in album form, and partially in panoramic connection, by the photographer, Mr. A. B. Wilse, of Seattle.

PLATE I.

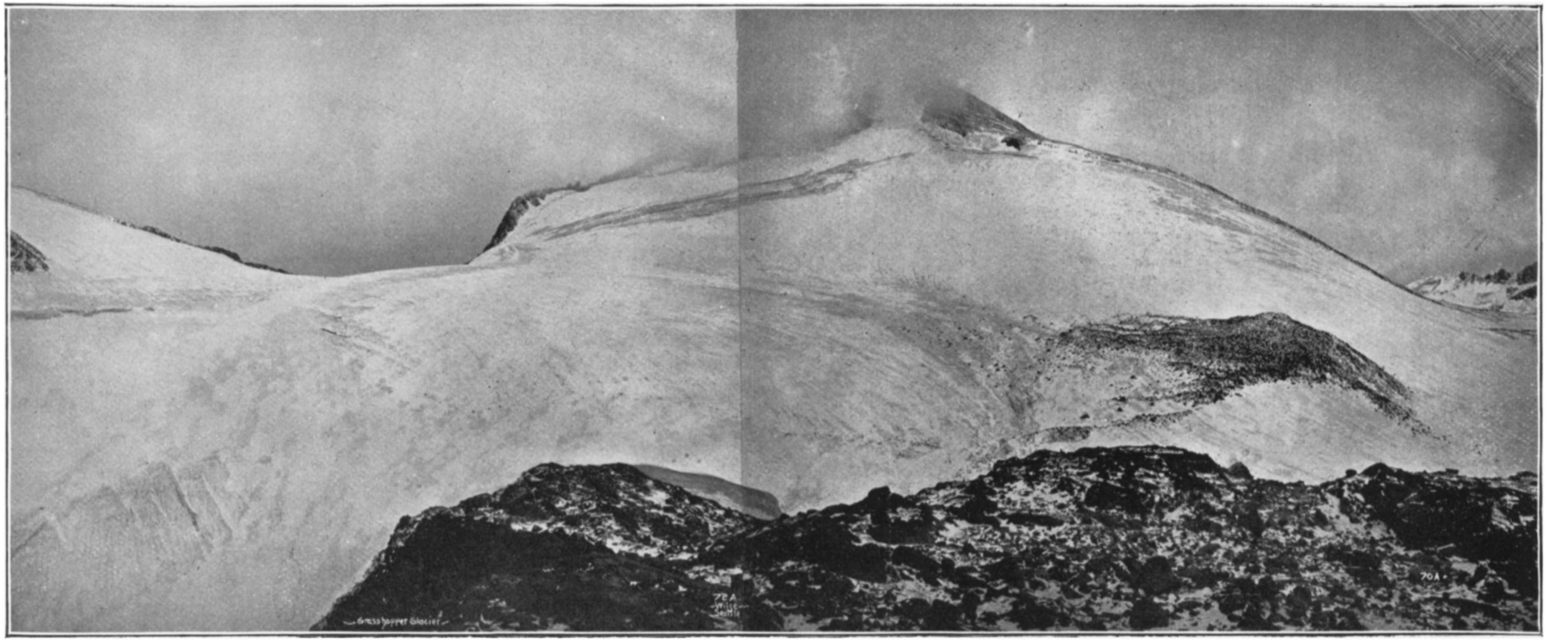
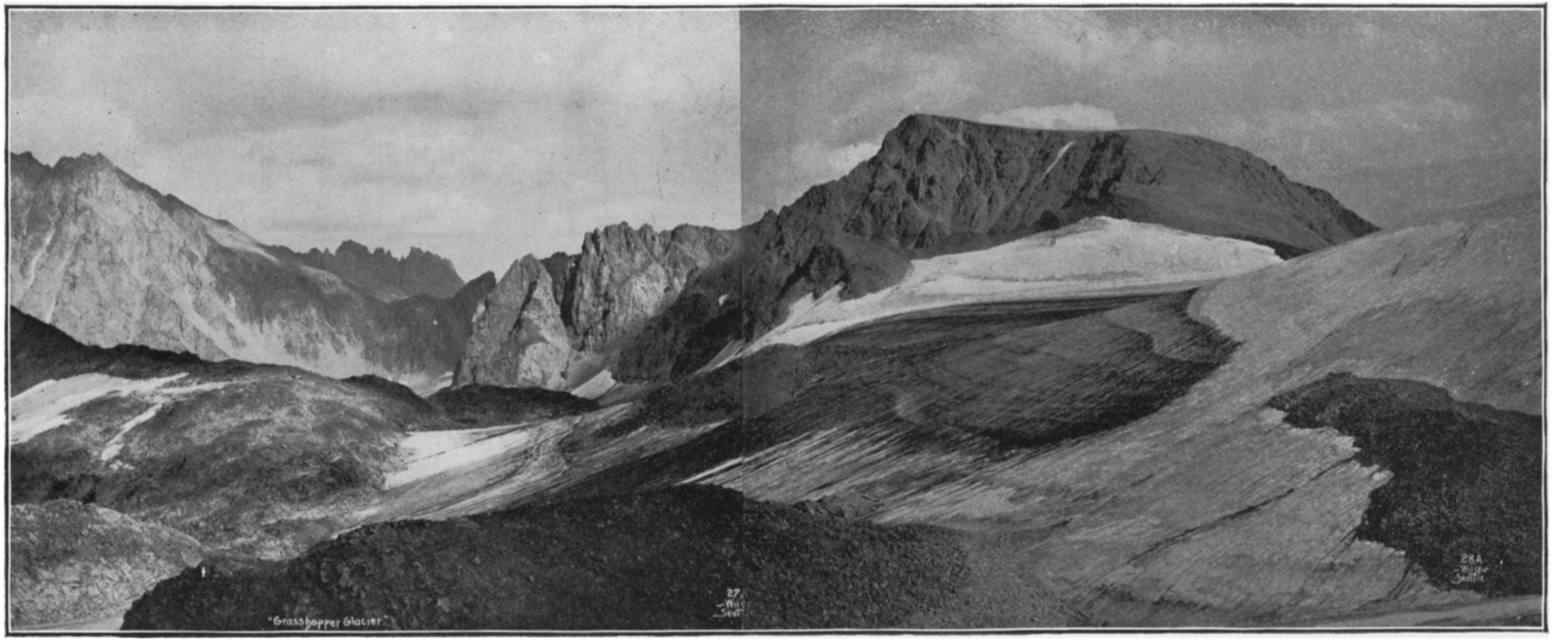


PLATE II.



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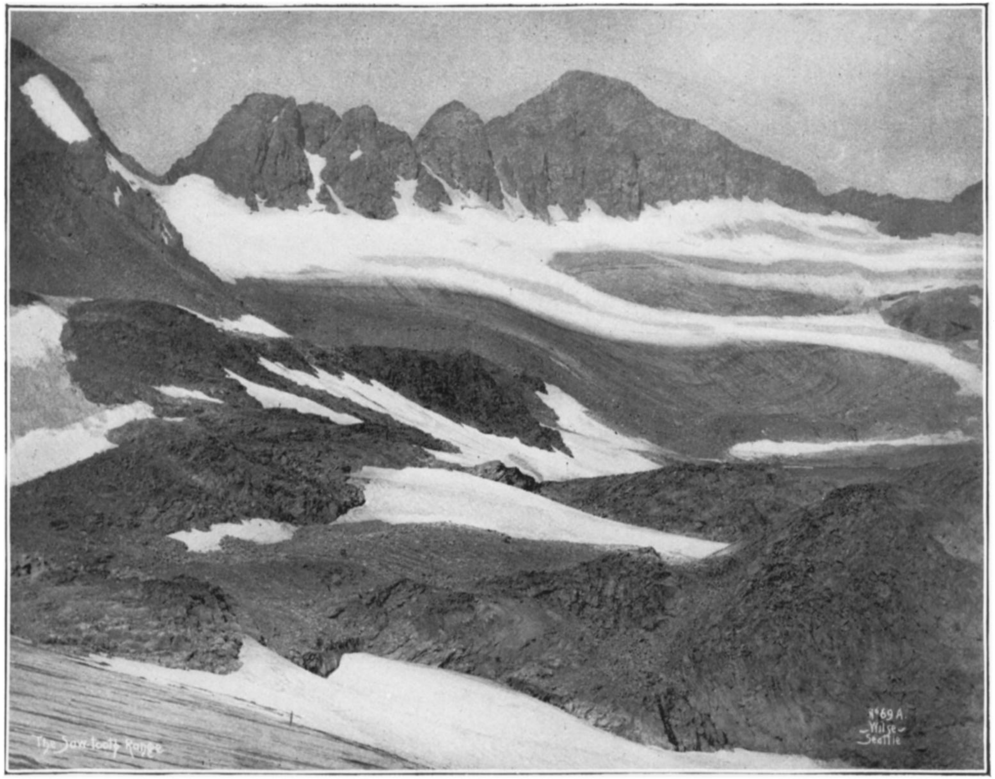

PLATE IV.

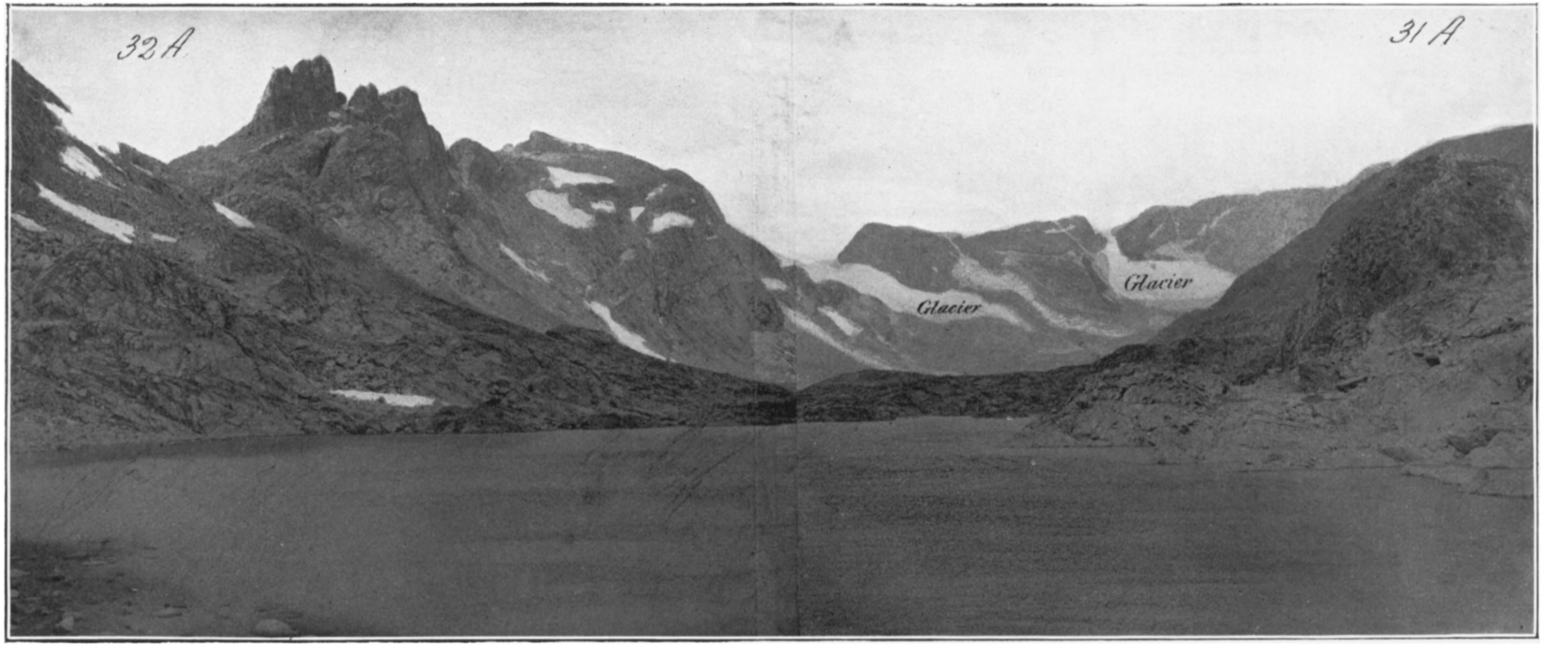

PLATE V.